SECTION C — (3 × 10 = 30 marks)

Answer any THREE questions.

16. If $y=\left(x+\sqrt{x^2+1}\right)^m$, show that $\left(x^2+1\right)y_{n+2}+(2n+1)xy_{n+1}+\left(n^2-m^2\right)y_n=0$.

17. Solve $\left(D^2+2D-3\right)y=e^x\cos x+e^{-2x}$.

18. Eliminate the arbitrary function f and y from $z=xf(y)+yg(x)$.

19. Compute $\int_C \overline{F}\cdot d\overline{r}$ along $y^2=4x$ from (0, 0) to (4, 4) if (a) $\overline{F}=x\overline{j}-y\overline{i}$ (b) $\overline{F}=3x^2y\overline{i}+\left(x^3-2y^2\right)\overline{j}$.

20. Find the Fourier Series for the function $x\sin n$ in $(-\pi, \pi)$.

APRIL/MAY 2025

23UEEL22 — BASIC MATHEMATICS — II (ELECTIVE)

Time : Three hours Maximum : 75 marks

Shanmuga Industries Arts & Science College T.V.Malai

SECTION A — (10 × 2 = 20 marks)

Answer ALL questions.

1. Write the statement of Leibnitz's theorem.

2. If $x=r\cos\theta$, $y=r\sin\theta$, then find $\frac{\partial(x, y)}{\partial(r, \theta)}$.

3. Find the complementary function of $\left(D^2+5D+4\right)y=0$.

4. Find the particular integral of $\left(D^2-4D+13\right)y=e^{2x}$.

5. Eliminate the arbitrary function f from $z=e^y f(x+y)$.

6. Eliminate the constant 'a' and 'b' from $z=ax+b$.

7. Determine the constant 'a' so that the vector $\overline{F} = (x+3y)\overline{i} + (y-2z)\overline{j} + (x+az)\overline{k}$ is solenoidal.

8. Find the curl of $x^2y\overline{i} + y^2z\overline{j} + z^2x\overline{k}$.

9. Evaluate $\int x^3 \sin x dx$.

10. Define Dirichlet's Conditions.

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SECTION B — ($5 \times 5 = 25$ marks)

Answer ALL questions.

11. (a) If $x = r\sin\theta\cos\phi$, $y = r\sin\theta\sin\phi$, $z = r\cos\theta$, find the Jacobian of x, y, z with respect to r, θ, ϕ.

Or

(b) If $y = \frac{3}{(x+1)(2x-1)}$, find y_n.

12. (a) Solve $(D^2 + 3D + 2)y = e^{-2x} + \sin x$.

Or

(b) Solve $(D^2 + 4D + 4)y = x^2$.

13. (a) Eliminate f and ϕ from $z = f(x+ay) + \phi(x-ay)$.

Or

(b) Eliminate the arbitrary function f from $f(x^2 + y^2 + z^2, z^2 - 2xy) = 0$.

14. (a) Show that $\nabla^2 \log r = \frac{1}{r^2}$.

Or

(b) Find the directional derivative of the function $xy + yz + zx$ at (1, 1, 3) in the direction whose d.c.s. are $\frac{1}{3}, \frac{2}{3}, \frac{2}{3}$.

15. (a) Evaluate $\int x^3 \cos 2x dx$.

Or

(b) Find the Fourier series for the function $f(x) = |x|$ in $(-\pi, \pi)$.